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EXAMINER	
MONDT, JOHANNES P	

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3663	

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11/27/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/763,353	HOFFMAN ET AL.	
	Examiner	**Art Unit**	
	Johannes P. Mondt	3663	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 27 August 2007.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *4,6-9,11,12,19,21-24,26, 29,31-39,48 and 50-67* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *4,6-9,11,12,19,21-24,26,29,31-39,48 and 50-67* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Reopening of Prosecution After Appeal Brief.

In view of the Appeal Brief filed on 8/27/07, PROSECUTION IS HEREBY REOPENED. New Grounds of Rejection are set forth below.

To avoid abandonment of the application, appellant must exercise one of the following two options:

(1) file a reply under 37 CFR 1.111 (if this Office action is non-final) or a reply under 37 CFR 1.113 (if this Office action is final); or,

(2) initiate a new appeal by filing a notice of appeal under 37 CFR 41.31 followed by an appeal brief under 37 CFR 41.37. The previously paid notice of appeal fee and appeal brief fee can be applied to the new appeal. If, however, the appeal fees set forth in 37 CFR 41.20 have been increased since they were previously paid, then appellant must pay the difference between the increased fees and the amount previously paid.

A Supervisory Patent Examiner (SPE) has approved of re-opening prosecution.

Supervisory Primary Examiner:

Jack Keith
TC3600, Art Unit: 3663)

Claim Rejections - 35 USC § 102

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. ***Claims 4, 6-9, 11, 26, 29, 31-36, 48 and 50-59*** are rejected under 35 U.S.C. 102(e) as being anticipated by Carcia et al (US 2004/0127038 A1) (cited previously; IDS).

Carcia et al teach a semiconductor device (thin film transistor; see title), comprising: a source electrode ("Source", Figure 3, also: inherent in thin film transistor); a drain electrode ("Drain", Figure 3, equally inherent on thin film transistor), a channel coupled to the source and drain electrode (zinc oxide comprising semiconductor layer; see Figure 3 and [0042]; said channel also is inherent in any thin film transistor) and comprised of a ternary compound containing zinc, tin and oxygen (see [0010]), where at least a portion of the channel is formed from a zinc-tin oxide compound having the stoichiometric formula Zn2SnO4 (namely: one of said "combinations", especially the combination $2ZnO + SnO_2 \rightarrow Zn_2SnO_4$); and a gate electrode ("Gate" in Figure 3; equally inherent in any thin film transistor) configured to permit application of an electric field to the channel (which is the very function of a gate) (Examiner note: only very few

elementary oxides are listed of which combinations are disclosed to be included as well).

On claim 6: the limitation “substantially amorphous” is met by Carcia et al, because inherently sputtering creates substantially amorphous forms of zinc oxide based oxides, as witnessed for example by Henrichs (US 2003/0185266 A1) ([0046], not cited here other than for establishment of fact; and cited previously).

On claim 7: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claims 8-9: the limitations of claims 8 and 9 are met by virtue of the finite dissociation constant of Zn_2SnO_4. For the finiteness of said dissociation constant the examiner has previously taken official notice. Accordingly, the finite dissociation constant of Zn2SnO4 is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 11: The limitation “is adapted to be deposited using an RF sputtering process”, is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product

"gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

In the underlying case it is therefore only parenthetically mentioned that indeed the channel of the prior art is adapted to be deposited using RF sputtering ([0010] and [0047]).

On claim 26: the examiner takes official notice that the limitation defined by this claim is inherently met, by any thin film transistor by definition of its gate. The official notice has not been traversed, and accordingly the subject matter of it is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 29: at least a portion of the channel layer is formed from a zinc-tin oxide compound having the following stoichiometry: Zn_2SnO_4 (see [0010]).

On claim 31: the limitation "substantially amorphous" is met by Carcia et al, because inherently sputtering creates substantially amorphous forms of zinc oxide based oxides, as witnessed for example by Henrichs (US 2003/0185266 A1) ([0046], not cited here other than for establishment of fact).

On claim 32: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claims 33-34: these further limitations, i.e., the same as of claims 8 and 9, are met by virtue of the finite dissociation constant of Zn_2SnO_4. For the finiteness of said

dissociation constant the examiner has previously taken official notice. Applicant has not challenged said official notice. Accordingly, the finite dissociation constant of Zn2SnO4 is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 35: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claim 36: The limitation "is adapted to be deposited using an RF sputtering process", is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not. In the underlying case it is therefore only parenthetically mentioned that indeed the channel of the prior art is adapted to be deposited using RF sputtering ([0010] and [0047]).

On claim 48: Carcia et al teach a display (their claim 16) comprising: a plurality of display elements configured to being capable to operate collectively to display images,

wherein each of the display elements includes a semiconductor device configured to control light emitted by the display element (namely: the transparent oxide semiconductor transistors; see their claim 16), the semiconductor device including: a source electrode ("Source", Figure 3, also: inherent in thin film transistor); a drain electrode ("Drain", Figure 3, equally inherent on thin film transistor), a channel coupled to the source and drain electrode (zinc oxide comprising semiconductor layer; see Figure 3 and [0042]; said channel also is inherent in any thin film transistor) and comprised of a ternary compound containing zinc, tin and oxygen (see [0010]), where at least a portion of the channel is formed from a zinc-tin oxide compound having the stoichiometric formula Zn2SnO4 (namely: one of said "combinations", especially the combination $2ZnO + SnO_2 \rightarrow Zn_2SnO_4$); and a gate electrode ("Gate" in Figure 3; equally inherent in any thin film transistor) configured to permit application of an electric field to the channel (which is the very function of a gate).

On claim 50: Carcia et al teach a semiconductor device (TFT), comprising:

a source electrode, a drain electrode, a channel coupled to the source electrode and the drain electrode and comprised of a ternary compound containing zinc, tin and oxygen ([0010]); and a gate electrode by definition configured to permit application of an electric field to the channel (N.B.: only its capability to do so is patentable, and said capability is inherent in "gate" of a field effect transistor, hence also of "gate" of a thin film transistor.

On claims 51-52: Carcia et al teach that at least a portion of the channel is formed from a zinc-tin oxide compound having the following stoichiometry: $Zn_xSn_yO_4$

where x, y and z have positive (hence automatically non-zero) values, in particular ZnSnO3 ([0010]), because Carcia et al teach any combination of four different binary oxide compounds including ZnO and SnO_2, of which $ZnSnO_3$ is one of six such ternary combinations.

On claim 53: For j=0.5, which is in the claimed range, the stoichiometric formula corresponds to a single compound, namely $ZnSnO_3$ because only the ratios of the stoichiometric parameter values have physical meaning.

On claim 54: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claim 55: the gate electrode in Carcia et al is physically separated from the channel by a dielectric material (SiO_2 in Figure 3, [0046]).

On claim 56: Carcia et al teach a semiconductor device (thin film transistor; see title), comprising:

a source electrode ("Source", Figure 3, also: inherent in thin film transistor);

a drain electrode ("Drain", Figure 3, equally inherent on thin film transistor),

a gate electrode, and

means for providing a channel configured to permit movement of electric charge therethrough between the source and drain electrodes in response to a voltage applied at the gate electrode (zinc oxide comprising semiconductor as delineated by [0009]-[0010]; see also [0042] and [0053]); said source electrode, drain electrode, gate electrode and channel being inherent in any thin film transistor, being a field effect

transistor), the means for providing a channel formed at least in part from a ternary compound containing zinc, tin and oxygen, i.e., Zn_2SnO_4 (see [0009]-[0010]).

On claims 57-59: said means, i.e., said semiconductor being a ternary compound $Zn_xSn_yO_z$ (see again [0009]-[0010]), in particular, through the taught combination of ZnO and SnO_2: $ZnSnO_3$ (loc.cit.) (hence meeting claim 58), which is identical to $(ZnO)_j$ $(SnO2)_{1-j}$ for j=1/2, which is in the range as claimed (hence meeting claim 59).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. ***Claims 19, 21, 22 and 24*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al (US 2004/0127038 A1) (cited previously, and IDS) in view of Taylor (4,521,698) (cited previously).

On claim 19: Carcia et al teach a three-port device (source, drain and gate being the three ports), comprising: a source electrode ("Source"; Figure 3); a drain electrode ("Drain"; cf. Figure 3); a gate electrode (""Gate"; Figure 3); furthermore, in reference to the claim limitation "means for providing a channel configured to permit movement of electric charges there-through between the source electrode and the gate electrode, intended use and other types of functional language must result in a structural difference between the claimed invention and the prior art in order to patentably

distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim. In re Casey, 152 USPQ 235 (CCPA 1967); In re Otto , 136 USPQ 458, 459 (CCPA 1963).

In the underlying case, it is thus only parenthetically mentioned that indeed the prior art by Carcia et al teaches a means for providing channel disposed between the source electrode and the drain electrode (said means being a semiconducting oxide layer comprising zinc separating source and channel with a gate electrode sufficiently nearby to produce a channel when given a voltage that either accumulates, depletes or inverts the interface between the semiconducting oxide layer and a dielectric layer separating gate from semiconductor oxide layer; furthermore, channel is inherent in the thin film transistor by Carcia et al and is implied by the existence of a gate near a channel forming substance, as the ZnO area in Figure 3), inherently permitting movement of electric charge there-through between source and drain in response to a voltage applied at the gate electrode, the means for providing a channel formed at least in part from a ternary compound containing zinc, tin and oxygen, where the means for providing a channel includes means for providing a semiconductor formed from a zinc-tin oxide compound having the stoichiometry Zn_2SnO_4.

Also, the limitation "means for providing a semiconductor" (second line from below) constitutes a product-by-process limitation, because, while said channel comes about through a method of use (application of voltage to gate), the "means for providing a semiconductor is a limitation on how to make said semiconductor.

The limitation is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

Carcia et al do not necessarily teach the limitation on movement of electric charge between source and gate electrode in response to voltage (lines 6-8). *However, it would have been obvious to include said limitation in view of Taylor, who, in a patent on insulated gate field effect transistors, namely MOSFETs*, hence related art, teach the use thereof wherein gate and drain are conductively connected so as to avoid hot electron effects (title, abstract, Figure 3; in particular transistor 224; and columns 1-3).

Motivation to include the teaching by Taylor at least derives from the generic undesirability of hot electron effects, i.e., effect whereby the acceleration of electrons due to the voltage head between source and drain leads to electron-electron collisions upon the impact on the drain region of accelerated electrons from the

channel, resulting in the excitation of valence electrons into the conduction band, i.e., to electron-hole pair production, resulting, due to the relatively large effective mass of the holes, in unwanted further bias of the semiconductor region near the channel.

On claim 21: the limitation "substantially amorphous" is met by Carcia et al, because inherently sputtering creates substantially amorphous forms of zinc oxide based oxides, as witnessed for example by Henrichs (US 2003/0185266 A1) ([0046], not cited here other than for establishment of fact).

On claim 22: one or more of the source, drain and gate electrodes are fabricated so as to be at least partially transparent (all of gate, drain and source electrodes are made of transparent zinc oxide; see Example 7, [0053]).

On claim 24: the semiconductor device by Carcia et al further comprises a dielectric disposed between and physically separating the gate electrode from the semiconductor layer that provides the channel (SiO_2 layer in Figure 3). Furthermore, means for providing a dielectric" constitutes a product-by-process limitation, because said means is not a structural aspects but instead merely a means for providing, i.e., a means for making a structural component. The limitation is only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed.

Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

3. ***Claims 12*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al as applied to claim 50, in view of Hong et al (6,674,495 B1) (cited previously).

As detailed above, Carcia et al anticipate claim 50. Carcia et al do not necessarily teach the further limitation that the source and drain electrodes are formed from an indium-tin oxide material. However, it would have been obvious to include this further limitation in view of Hong et al, who, in a patent on a thin film transistor array panel for display, hence analogous art (see title and abstract), teach the source and drain electrodes to be ITO (i.e., indium-tin oxide) electrodes (see column 20, lines 25-37, and e.g., Figures 1 and 23) in a patent in which ITO and zinc oxide are both respectively cited for conductivity and transparency, two important advantages for electrode material in a display (see, e.g., columns 9 and 20). Inherently, source and drain electrodes in any thin film transistor, in fact in any field effect transistor, are separate from one another. Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416. Furthermore, the limitations "formed from"

and "patterned" constitute product-by-process limitations and are only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

4. ***Claim 23*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al in view of Hong et al (6,674,495 B1) (cited previously).

As detailed above, claim 56 is anticipated by Carcia et al. Carcia et al does not necessarily teach the further limitation that the source and drain electrodes are formed from an indium-tin oxide material. However, it would have been obvious to include this further limitation in view of Hong et al, who, in a patent on a thin film transistor array panel for display, hence analogous art (see title and abstract), teach the source and drain electrodes to be ITO (i.e., indium-tin oxide) electrodes (see column 20, lines 25-37, and e.g., Figures 1 and 23) in a patent in which ITO and zinc oxide are both *ex aequo* cited for conductivity and transparency, two important advantages for electrode

material in a display (see, e.g., columns 9 and 20). Inherently, source and drain electrodes in any thin film transistor, in fact in any field effect transistor, are separate from one another. Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416. Furthermore, the limitations "formed from" and "patterned" constitute product-by-process limitations and are only of patentable weight in as much as the method steps distinguish the final structure, and to the extent not impacting final structure are taken to be product-by-process limitations and non-limiting. A product by process claim is directed to the product per se, no matter how they are actually made. See In re Fessman, 180 USPQ 324, 326 (CCPA 1974); In re Marosi et al, 218 USPQ 289, 292 (Fed. Cir. 1983), and In re Thorpe, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make clear that it is the patentability of the final structure of the product "gleaned" from the process steps that must be determined in a "product-by-process" claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old or obvious product produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

5. ***Claims 14 and 38*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al in view of Krivokapic et al (6,100,558) (cited previously), and Carcia et al and Cillessen et al in further view of Krivokapic et al, respectively.

As detailed above, Carcia et al anticipate claim 55 and claim 60 is unpatentable over Carcia et al in view of Cillessen et al.

Carcia et al do not necessarily teach the limitation that said dielectric material is an aluminum-titanium oxide material. *However, it would have been obvious to include said limitation as witnessed, for instance, by Krivokapic et al,* teaching a combination of Al_2O_3 and TiO_2 for the gate dielectric layer the purpose of increasing the dielectric constant of the gate oxide (Figure 19 and column 8, lines 3-26) so as to overcome adverse effects of small defects or contamination of the gate oxide material (see “Background of the Invention”, col. 1). *Motivation* to include the teaching by Krivokapic et al in the invention by Carcia et al derives from the consequent reduction in defective operation.

6. ***Claims 15 and 39*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al and Krivokapic et al, and over Carcia et al, Cillessen et al and Krivokapic et al as applied to claims 14 and 38, respectively, above, and further in view of Hornik et al (US 2004/0169210 A1) (cited previously).

As detailed above, claims 14 and 38 are unpatentable over Carcia et al in view of Krivokapic et al.

Neither Carcia et al nor Krivokapic et al necessarily teach the further limitation defined by claims 15 or 39, respectively.

However, it would have been obvious to include said further limitation in view of *Hornik et al,* who, in a patent on barrier material against the diffusion of hydrogen into a high dielectric constant layer such as PZT during passivation of gate oxide, teaches to protect said layer of PZT with a pair of Al_2O_3 layers with a TiO_2 layer in between (see

[0006] and [0024]). *Because PZT is also included in the teaching by Krivokapic et al as one of the gate oxide materials, it would have been obvious* to include the teaching on hydrogen diffusion barrier structure against deterioration of PZT also in the gate oxide by Krivokapic et al. To protect the PZT layer optimally it would furthermore have been obvious to provide the $Al_2O_3/TiO_2/Al_2O_3$ layer on both sides of the PZT layer, thus meeting the claim limitation. *Motivation* to include the teaching by Hornik et al derives immediately from the increased integrity resulting from the protection of the PZT against a lowering of its dielectric constant due to hydrogen diffusion.

7. ***Claims 60-63*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al (US 2004/0127038) in view of Cillessen et al (5,744,864) (previously cited and made of record by applicant in IDS).

Carcia et al teach a thin film transistor (see "Summary of the Invention"), inherently comprising a gate electrode (see also Figure 3, "VgGate" indicating voltage to gate electrode underneath an n+ gate region), a channel layer (see also Figure 3, the region between source and drain abutting both) and dielectric material disposed between and separating the gate electrode and channel layer (see Figure 3, the region separating source, channel and drain from gate region and gate electrode); first and second electrodes spaced from each other and disposed adjacent the channel layer on a side opposite the dielectric material, such that the channel layer is disposed between and electrically separates the first and second electrodes. Although the provisional application by Carcia et al does not disclose the limitation that the channel is formed of zinc-tin-oxide, it would have been obvious to include said limitation in view of Cillessen

et al, who, in a patent on a semiconductor device with source, drain and insulated gate (see Figure 4 and col. 4, l. 27+), hence art analogous to Carcia et al, teach that the channel is formed of covalent oxide of a non-transition metal including ZnO , or SnO_2 or mixtures or compounds thereof (col. 5, l. 30-50). *The claim would have been obvious because* one of ordinary skill has good reason to pursue the known options within his or her technical grasp; if this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 61: Cillessen et al explicitly include combinations of compounds (col. 5, l. 30-50), while the notation on stoichiometry is not further limiting, given a compound consisting of zinc, tin and oxygen.

On claim 62: ZnSnO3 is merely the simplest example of a compound formed of ZnO and SnO2 as taught by Cillessen et al (col. 5, l. 41-42), namely: ZnO + SnO2 = ZnSnO3,

On claim 63: for j=1/2, - which is within the claimed range, the compound claimed here is identical to the one recited in claim 62.

8. ***Claims 64-67*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Carcia et al in view of Cillessen et al (5,744,864) (previously cited and made of record by applicant in IDS) and Ando et al (6,184,946 B1) (cited previously).

Carcia et al teach a semiconductor device including a source electrode, a drain electrode, a channel coupled to the source electrode and the drain electrode; and a gate electrode configured to permit application of an electric field to the channel, all of the above inherent in the thin film transistor (TFT) by Carcia, and disclosed in Figure 3,

Examples 1-7. Although the provisional application by Carcia et al does not disclose the limitation that the channel is formed of zinc-tin-oxide, it would have been obvious to include said limitation in view of Cillessen et al, who, in a patent on a semiconductor device with source, drain and insulated gate (see Figure 4 and col. 4, l. 27+), hence art analogous to Carcia et al, teach that the channel is formed of covalent oxide of a non-transition metal including ZnO , or SnO_2 or mixtures or compounds thereof (col. 5, l. 30-50). *The claim would have been obvious because* one of ordinary skill has good reason to pursue the known options within his or her technical grasp; if this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

Carcia et al do not necessarily teach the limitation that said semiconductor device is included in a display comprising a plurality of display elements configured to operate collectively to display images, where each of the display elements includes a semiconductor device configured to control light emitted by the display element. *However, it would have been obvious to include said further limitation in view of Ando et al, who*, in a patent on thin film transistor based applications to display technology (title and abstract), hence analogous art, teach the application of thin film transistors (TFTs) (col. 4, l. 3-25), in particular as switching elements (abstract) used for switching in a method for controlling an active matrix display (title, abstract), wherein the TFT selectively controls activation and deactivation of a pixel of the active matrix display by selectively controlling the gate voltage (cols. 1-col. 2, l. 5: that is how thin film transistor function). *Motivation* to include the teaching by Ando et al in the invention by Carcia et

al derives from the obvious advantage of applying a transparent and high mobility TFT such as taught by Carcia et al to said active matrix display because little light is lost by absorption by the thin film transistor (said semiconductor layer being transparent to light; Figure 7 and discussion) while the device speed is still high as witnessed by the excellent current-voltage characteristics (i.e., mobility) (see Figures 4-9).

On claim 65: Cillessen et al explicitly include combinations of compounds (col. 5, l. 30-50), while the notation on stoichiometry is not further limiting, given a compound consisting of zinc, tin and oxygen.

On claim 66: ZnSnO3 is merely the simplest example of a compound formed of ZnO and SnO2 as taught by Cillessen et al (col. 5, l. 41-42), namely: ZnO + SnO2 = ZnSnO3,

On claim 67: for j=1/2, - which is within the claimed range, the compound claimed here is identical to the one recited in claim 66.

9. ***Claims 4, 7-9, 12, 19, 22-24, 26, 29, 32-35, 37, 48, 50-53, 54- 59, 60-63 and 64-67*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Cillessen et al (5,744,864).

Cillessen et al teach a thin film transistor (see col. 1, l. 13) comprising (inherently) a source electrode and a drain electrode (2 and 3 or 3 and 2) (col. 4, l. 26-58 and abstract); a channel 4 (col. 4, l. 35 and abstract) coupled to the source and drain electrodes and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43), and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In. The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO2, namely: ZnO + SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 19: Cillessen et al teach a three-port semiconductor device (thin film transistor; see col. 1, l. 5-18), comprising (inherently) a source electrode and a drain electrode, and a gate electrode (2, 3 and 5 or 3, 2 and 5: see abstract col. 4, l. 27+; Figure 4); and means for providing a channel 4 (col. 4, l. 35 and abstract) (Examiner note: said means for providing a channel in light of the specification, and conform 35 U.S.C. 112, sixth paragraph, identified as element 18 in said Specification, which is a channel region, within which by action of the gate a (narrow) channel is formed in the ON state), the means for providing a channel formed at least in part from a covalent oxide of a non-transition metal (col. 4, l. 34-43), and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides, and preferably a covalent oxide from the group

Sn, Zn, In (col. 5, l. 50-60). The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4 is indeed a simple compound formed from ZnO and SnO2, namely: ZnO + SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 48: Cillessen et al teach a display (col. 2, l. 63 – col. 3, l. 24), comprising a plurality of display elements (loc. cit.) configured to operate collectively to display images (col. 3, l. 25-40), where each of the display elements includes a semiconductor device configured to control light emitted by the display element (being a switching element (see col. 1, l. 5+ and col. 2, l. 63 – col. 3, l. 40), the semiconductor device including: a source electrode and a drain electrode (2 and 3 or 3 and 2, resp.) (col. 4, l. 27-58 and abstract); a channel coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43), and a gate electrode 5 (col. 4, l. 36 and abstract) configured to permit application of an electric field to the channel (see Figure 4).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides, and preferable a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4, although not explicitly taught, is indeed a simple compound formed from ZnO and SnO2, namely: ZnO + SnO_2. The claim would have been obvious

because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 50: Cillessen et al teach a semiconductor device (title), comprising: a source electrode and a drain electrode (2 and 3, or 3 and 2; see abstract and col. 4, l. 27-58); a channel 4 (abstract and col. 4, l. 27-58) coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 4, l. 34-43); an a gate electrode 5 (col. 4, l. 27+ and abstract) configured to permit application of an electric field to the channel (see Figure 4).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide of the group Sn, Zn, In (col. 5, l. 50-60). The formation of a ternary zinc-tin-oxide compound, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 56: Cillessen et al teach a three-port semiconductor device (title, abstract and col. 1, l. 5-12; also: Figure 4), comprising: a source electrode and drain electrode (2/3 or 3/2; col. 4, l. 27+ and abstract), a gate electrode (col. 4, l. 27+ and abstract); means for providing a channel 4 (col. 4, l. 35 and abstract) (Examiner note:

said means for providing a channel in light of the specification, and conform 35 U.S.C. 112, sixth paragraph, identified as element 18 in said Specification, which is a channel region, within which by action of the gate a (narrow) channel is formed in the ON state), the means for providing a channel formed at least in part from a covalent oxide of a non-transition metal (col. 4, l. 34-43).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides, but preferably from such covalent oxide of Zn, Sn, In. (col. 5, l. 50-60), preferably a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a ternary zinc-tin-oxide compound, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 60: Cillessen et al teach a thin-film transistor (col. 1, l. 5-12: see especially the reference to Japanese Patent Application 60-198861 as defining the kind of device to which the invention relates, which is a thin-film transistor), comprising: a gate electrode 5 (abstract and col. 4, l. 27-58); a channel layer 4 formed of a covalent oxide of a non-transition metal (col. 5, l. 30-50), preferably an oxide from Zn, Sn, In; a dielectric material 6 disposed between and separating the gate electrode and the channel layer (Figure 4, abstract and col. 4, l. 27-58); and first and second electrodes 2 and 3 (abstract and col. 4, l. 27-58) spaced from each other and disposed adjacent the

channel layer on a side of the channel layer 4 opposite the dielectric material 6 such that the channel layer is disposed between and electrically separates said first and second electrodes (Figure 4 and abstract).

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In. The formation of a ternary zinc-tin-oxide material, although not explicitly recited by Cillessen et al, is indeed obtainable as either mixture or compound from ZnO and SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claim 64: Cillessen et al teach a display (col. 2, l. 63 – col. 3, l. 24), comprising: a plurality of display elements configured to operate collectively to display images (loc.cit and col. 3, l. 25-40), where each of the display elements includes a semiconductor device (their thin film transistor (col. 1, l. 5-12) as 'switching element'; see col. 3, l. 6) configured to control light emitted by the display element, the semiconductor element including: a source electrode and a drain electrode (2 and 3 or 3 and 2; abstract and col. 4, l. 27-58; see Figure 4) a channel coupled to the source electrode and the drain electrode and comprised of a covalent oxide of a non-transition metal (col. 5, l. 30-50); and a gate electrode 5 (abstract and col. 4, l. 27-58) configured to permit application of an electric field to the channel.

Cillessen et al also teach said covalent oxide of a non-transition metal in terms of examples of a list of eight such oxides, - including both ZnO and SnO_2, and mixtures or compounds formed from said oxides; and preferably a covalent oxide from the group Sn, Zn, In (col. 5, l. 50-60). The formation of a ternary compound containing zinc, tin and oxide, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claims 7, 22, 32, 35 and 54: source, drain and gate electrodes are fabricated so as to be at least partially transparent (see abstract).

On claims 8-9 and 33-34: the limitations of claims 8 and 9 are met by virtue of the finite dissociation constant of a ternary zinc-tin-oxide compound. For the finiteness of said dissociation constant the examiner has previously taken official notice. Accordingly, the finite dissociation constant of, for instance, Zn2SnO4 is considered Prior Art admitted by Applicant (cf. MPEP 2144.03[R-1]).

On claim 12, 23 and 37: the source and drain electrodes are formed from an indium-tin-oxide material (col. 7, l. 41 – col. 8, l. 39, especially col. 8, l. 29). The manner of fabrication is without patentable weight, being a product-by-process limitation; however, the manner of fabrication does include patterning the source/drain electrodes (loc.cit.), while the final result is their physical separation, without which the thin film transistor would not be operative (Figure 4).

On claim 24 and 55: the semiconductor device further comprises means for providing a dielectric 6 (abstract and col. 4, l. 27-58) (interpreted in light of the specification as dielectric medium 90) disposed between and physically separating the gate electrode from the means for providing a channel.

On claim 26: the limitation of this claim is simply inherent to all field effect transistors, including the thin film transistors. See also col. 6, l. 46+.

On claim 29: The formation of a zinc-tin-oxide compound having the stoichiometry Zn_2SnO_4, although not explicitly taught, is indeed a simple compound formed from ZnO and SnO2, namely: ZnO + SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claims 51and 57: the stoichiometry as claimed does not further limit the zinc-tin-oxygen compound.

On claim 61: Cillesen et al further teach the channel to be formed of a covalent oxide of a non-transition metal (col. 5, l. 30-50), preferably a covalent oxide of the group Sn, Zn, In (col. 5, l. 50-60). The formation of a ternary compound containing zinc, tin and oxide, although not explicitly recited by Cillessen et al, is indeed a simple compound formed from ZnO and SnO_2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

On claims 52, 53, 58, 59, 62, 63, 66 and 67: given the teaching by Cillesen that the channel is formed of a covalent oxide of the non-transition metal (col. 5, l. 30-50) and its combinations including ternary compounds, and preferably be formed from the group Sn, Zn , In (col. 5, l. 30-60), the claims would have been obvious in light of the simple combination ZnO + SnO2 = ZnSnO3, which is identical to the stoichiometry formaulated with the parameter j for a value of j within the claimed range, namely j=1/2. The claim would have been obvious because one of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense.

10. ***Claims 6, 11, 31 and 36*** rejected under 35 U.S.C. 103(a) as being unpatentable over Cillessen et al in view of Carcia et al (2004/0127038 A1) (cited previously). Although Cillessen et al do not necessarily teach the further limitations of these claims, it would have been obvious to use RF, in particular magnetron, sputtering in view of Carcia et al (see [0010]), inherently yielding a substantially amorphous material. The claim would have been obvious because the technique (RF sputtering of covalent oxides of non-transition metals) was part of the ordinary capabilities of a person of ordinary skill in view of the technique for improvement in a very similar situation.

Response to Arguments

1. Applicant's arguments filed in Appeal Brief have been fully considered but they are not persuasive, although for other reasons examiner prefers to provide a new, non-

final, office action for reasons discussed below. In particular, counter to Arguments on pages 8-10 that the "combinations thereof" are not sufficient disclosure to anticipate every possible combination or subcombination of the listed oxides, the oxides listed by Carcia et al form a finite set while said combinations thereof are extremely limited in number, especially when one considers the simplest kind, i.e., ternary combinations thereof, namely: six. Examiner also responds that anyone of ordinary skill in the art of chemistry, which is the relevant subject for the claimed material composition of the channel region, would indeed immediately envisage the combinations ZnO + SnO2 and 2ZnO +SnO2 as essentially claimed by applicant. Therefore, Appellant's argument in not persuasive.

2. In response to Appellant's arguments in traverse of the rejections over Carcia and Taylor (pages 11-12), Appellant's argument is in part the same as under section 1 above, and is responded to in this respect by referring to the above comments, and in part alleges to teach away from a zinc-tin-oxide compound; however, examiner cannot find any teaching away, especially because the result of combining ZnO and SnO2 to a compound in the simplest possible fashion yields the claimed material, with reference to the chemical formulae in section 1 directly above.

3. In response to Appellant's arguments in traverse of the rejections over Carcia and Hong (page 13-14), are for the most part identical to the above arguments in section 2, and the response under section 2 directly above is herewith included by reference. To the additional comment based on Hong's teaching of hydrogenated

amorphous silicon, examiner sees no teaching away in another preferred embodiment, with reference to MPEP 2123, section II.

4. In response to Appellant's arguments in traverse of the rejections over Carcia, Taylor and Hong (page 14) arguments are identical to those discussed in section 3 above, and response by examiner is identical to section 3 above.

5. In response to the rejections over Carcia in view of Krivokapic et al (pages 14-15), the traverse appears to be restricted to the alleged failure of the teaching of the material for the channel, which does not depend on Krivokapic et al, and has been answered above (see sections 1-4 immediately above).

6. In response to the rejections over Carcia in view of Krivokapic et al and Hornik et al (pages 15-16), the traverse appears to be restricted to the alleged failure of the teaching of the material for the channel, which does not depend on Krivokapic et al or Hornik, and has been answered above (see sections 1-4 immediately above).

7. In response to the traverse of the rejections over Carcia et al in view of Ando et al, the failure to exemplify and the teaching of other embodiments are not a failure to teach, resp., teach other embodiments, and a forteriori is not a teaching away, with reference to MPEP 2123, section II.

8. However, in light of a review of the rejection, examiner discovered that there is no support for any oxide other than ZnO in Caria's provisional, and hence the anticipation rejection of claim 60 is herewith withdrawn.

9. Furthermore, the noted, and other, discrepancies in the Headings on dependent claims have been corrected.

10. Finally, upon review and especially in light of the recent US Supreme Court Decision on KSR International Co. vs. Teleflex Inc., 550 U.S.,- 82 USPQ2d 1385 (2007) a rejection under 35 U.S.C. 103(a) over Cillessen et al is herewith added.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P. Mondt whose telephone number is 571-272-1919. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jack W. Keith can be reached on 571-272-6878. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JPM
November 23, 2007

Primary Examiner:
Johannes Mondt (Art Unit: 3663)